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THE INFLUENCE OF SKELETAL DEFECTS, CONGENITAL AND ACQUIRED, UPON THE BODY IN HEALTH AND DISEASE.

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Among the many good results attained in the period of specialization through which we are passing has been the focusing of attention upon certain of the fundamental branches of knowledge necessary for a physician to possess. Little by little it has been found that many of the old theories in regard to disease were erroneous in whole or in part, and research has supplied in some instances at least a correct theory upon which to work. Much has still to be learned. Not all the problems are as yet solved. Scarcely a month goes by without some promising clue being discovered, and though most of them do not lead to the desired result, still the following of them up is bringing us a little nearer the truth. It seems strange sometimes that anatomy should be the branch of medicine to which we may still look for suggestions in the solution of our problems. It has been the groundwork of a physician's knowledge so long that it would appear at first thought it could have no secrets that had not already been revealed. Viewed from the standpoint of descriptive anatomy alone it is probable that there is not much to be added to what has been observed from the time of Vesalius to our present-day authorities. There is, however, another side to anatomy, and that is the comparative. The human being, as we study him, is looked at as the product of an evolutionary process operating through an immeasurably long period, and it may well be that we are still in a transitional stage. Environment and its necessities have imposed upon the evoluting creature, whatever it may have been, its impress. Adaptation to its surroundings has been a characteristic of a developing organism, whether we look upon the life history of an individual or of the race to which he belongs. Some of the functional adaptations are trivial, and others are more or less fundamental. Looked at from this standpoint it would seem that anatomy might still have many a lesson for us which should be valuable in preparing the way for a better understanding of some of our unsolved problems. In what is to follow, therefore, there will be presented to a considerable extent some of the attempts to profit by knowledge acquired from anatomic sources.

We are disposed to assume that the body is so endowed with energy and is so infinitely adaptable to changing conditions that its functions may be continued in a normal manner to permit of healthful existence and the output of a volume of energy proportioned to the capacity of the machine. It is true that in the human mechanism there is a wider latitude than there is in any other known mechanism for loss of force and for the performance of function under conditions which are, to say the least, adverse. What we do not realize, and have taken few steps to understand, is (1) to what extent anatomic defect influences the proper functional uses of the body; (2) to what degree and in what way these anatomic peculiarities may influence physiologic function; (3) to what kind of abnormal anatomic changes these perversions of function may give rise.

The history of the practice of medicine is replete with examples of the way the profession has tried to solve situations where anatomic disarrangements seemed to be the cause for a train of symptoms physically distressing to the patient. One need only mention the fact that a considerable part of gynecologic treatment has had such a supposition as its basis, and the fact that floating kidneys and other visceroptoses have been treated mechanically by the surgeon with this hypothesis in mind. Pain or some form of physical discomfort is the factor that leads a patient to seek advice from his physician in the majority of cases, and in the procurement of a total or partial relief of this both patient and physician lose sight of the underlying cause of this symptom and of effects which are oftentimes of more real significance than the pain itself. A more thorough knowledge and appreciation of the interdependence of physiologic function upon anatomic adaptation to environment and function is what is needed on the part of everyone who seeks to aid in the solution of medical problems in these days.

The results of the researches of laboratory investigators in the past twenty to thirty years have brought us to a position where a large part of the diseases which we are called upon to treat have been shown to be the result of infections. In those cases in which it has been possible to isolate and specifically identify the cause of an infection we are content for the present at least to assume that this is the prime and essential source of the disease and devote ourselves to the problem of trying to produce a vaccine with which to treat it. In certain conditions, however, we cannot isolate a specific bacteriologic cause for symptoms which in themselves are suggestive of infection, and we are forced to fall back upon what we designate autointoxication and assume that there is some undiscoverable source of infection in the body. In certain of this latter group of cases we are coming to the conclusion that anatomic visceral defects are capable of setting into operation faulty functional processes within the abdominal cavity, and that the patient becomes poisoned by the consequent interference with the machinery by which he should be rid of his waste physiologic products. In these cases nothing is brought in from the outside that was not already there, as has been assumed to be the case in the first-mentioned group; but we must not lose sight of the fact that we have no satisfactory scientific explanation of what the factor is that must be present beside the infecting organism to make possible the development of any infectious disease. We satisfy ourselves by saying that this factor is lowered resistance. If we are honest with ourselves we can recall innumerable instances where we have looked long and in vain for any evidence of such lowered resistance in cases where there has been no question about the infection. Flexner has recently shown that the organism which was capable of causing anterior poliomyelitis in a monkey was being carried in the nasopharynx of the healthy parents of a child who was then going through an attack of this disease without causing any symptoms in the hosts. Arbuthnot Lane is performing as a routine measure an intestinal short-circuiting operation in all children with bone tuberculosis, on the theory that visceroptosis in some of its forms is the cause for these infections. Indefensible as this position of Lane's seems to many of us it may well be that the lesson we should learn from it is that we must be on the alert to discover in some anatomic lack of adaptation the link that is so often missing in furnishing a complete explanation of the phenomena of infectious disease. If as time goes on such interrelationships should prove to be of frequent occurrence and others should be discovered not now even suspected, our whole plan of attack upon disease as the enemy of mankind will of necessity have to be remodelled. Numerous suggestive interrelationships between functional disturbances in the special senses dependent upon primary anatomic defects in one of the special sense organs might be cited as in line with this suggestion. Disturbances in the function of certain of the ductless glands give rise to serious upsets in the metabolism of the body, causing disarrangements in the functional activity of organs having at least no direct anatomic connection with the gland in question. What it was that was directly responsible for throwing the gland out of its proper functioning we are not in a position to say. Anatomic obstacles may reasonably well be looked to in explanation of a lack of functional adaptation here as elsewhere.

It is time, therefore, that all the knowledge which these years of activity on the part of trained clinical observers in special fields have accumulated, together with the results of laboratory research along physiologic and pathologic lines, should be made to converge upon the accumulation of anatomic data in our possession, which must be the foundation stone upon which every scientific conception of disease must rest. We must get away from the notions which have so strongly dominated our thought in the past, based upon a dead pathology. To be of help to us our pathology must be a living pathology and we must realize that most of the diseases which flesh is heir to are the result of perverted physiology. I believe that in the future we shall discover that anatomic defects, either congenital or acquired, will be at the root of physiologic perversions more often than we now appreciate.

Certain of the anatomic skeletal disarrangements have been carefully studied and some suggestive light has been thrown upon a type of joint trouble which Preiser has classed as static joint disease and about which he has written extensively.[1] He groups the joints under the heading of static units and shows how any defect in any member of a static unity causes every other member of that unity to suffer. As an example of how this works out he refers to the influence of a pronated foot or a knock-knee upon other parts of the static unit of which the foot and leg are members. So also in the arm he refers to the effects of a cubitus varus upon the shoulder girdle and the carrying function of the arm. He speaks of the effects upon the joints of a static unity in the way of interference with the use of the articular cartilages as an "incongruence," and says that the results of these incongruences are expressed through changes in cartilage, bone, and circulation, producing, as a terminal effect, disturbances in the nutrition of the joints. He points to the fact that these same disturbances or incongruences may be produced in joints as a result of old healed diseases, for example, tuberculosis, infectious arthritis, and juxta-epiphyseal osteomyelitis. Again, he shows that variations in the anatomic types of the pelvis, by rendering the normal bearing of the femoral head against the acetabular floor impossible, cause "incongruence" of the bones at the hip- and knee-joints which lead to permanent anatomic changes, interfering with function and giving rise to the symptoms of arthritis. It is impossible that such a condition as this in the pelvic girdle should exist for long without its giving rise to such disarrangements in the relationships of the lumbar and low dorsal vertebræ to each other that they in their turn should not manifest similar evidences of "incongruence" of articular surfaces, limitation of motion, and impairment of function. The significance of these primal anatomic defects is enhanced if there is coincidently present an inherited tendency to a diathesis such as that commonly denominated hypertrophic arthritis. In the shoulder girdle, whether from postural errors or anomalous development, we frequently meet with symptoms referable to the hand, forearm, shoulder, and cervicodorsal spine, which are due primarily to anatomic disarrangement of this "static unit," and as a result of this there develop nerve-root compressions, articular "incongruences," continuous strains upon ligamentous and muscular structures, which are of themselves painful, and result in impairment of function. Any one of the above-mentioned phenomena is of itself more or less distressing, and will, if permitted to continue, eventually exercise a harmful influence upon the patient as a whole.

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[1] Amer. Jour. Orth. Surg., vol. x, No. 1.

In the feet one is constantly brought into contact with patients who for one reason or another have neglected to give attention to minor static defects. The congested, swollen, and painful foot, which is normally flexible in spite of static defects, readily passes over into the rigid, contracted foot, in which there are articular "incongruences" and serious disability.

Preiser has grouped the symptoms of the statically diseased joints under three heads: (1) Difficulty in getting the joints to work easily and comfortably after prolonged rest; (2) relief from this difficulty after being limbered up; (3) renewal of pain and stiffness after prolonged use.

F. H. Martin,[2] in an article entitled "Perpendicular Pelvis," has called attention to anatomic anomalies of the bony pelvis which he believes to be a cause for the development of certain gynecologic difficulties.

Further citation of examples of this cause for symptoms having no other primal explanation than anatomic defect is hardly necessary for the purposes of this discussion. It will be noted that among these conditions which have been mentioned some are of congenital and some are of acquired origin. It is probable that under the right conditions and during the earlier periods of life faulty attitudes and the assumption of an habitually poor poise, whether sitting or standing, may graft upon the individual methods of the employment of the various muscle groups which permanently impair their efficiency, bring about faulty skeletal relations, and render difficult the application of the energy of the growing child to the activities which are an essential part of its growth and development. Even the superabundance of animal spirits, which is the heritage of the normal child, cannot overcome indefinitely the handicap imposed by skeletal incongruence, and many a case of physical incapacity and deterioration can be traced to this alone.[3]

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[2] Jour. Amer. Med. Assoc., July 29, 1912

If the old aphorism that "as the twig is bent so the tree inclines" has any application here it is evident that the time to prevent the more serious handicaps of adult life, which are of this character, is before the changes which render the figure incapable of remodeling have taken place. It is important that those who are custodians of the health, the physical efficiency, and mental vigor of the race should realize that the prime reason for insistence upon good carriage in youth is not for the sake of the appearance one makes, but for the absolute dependence of all, except the expressly endowed in these respects, upon their being able to meet the world without physical handicap.

Recently Dr. J. E. Goldthwait[4] has drawn attention to still another series of congenital skeletal anomalies that seem to have considerable significance. These are situated within the narrow limits of the pelvic girdle, including the last of the lumbar vertebræ. Here are anatomic structures capable of such disarrangement, either congenital or acquired, that they may give rise to physical incapacity and discomfort of considerable significance, and this without complication by any of the pathologic conditions common to bone. Some of these are the result of anomalies in development hitherto not supposed to have any clinical importance.

The primal condition of the progenitors of the human race was that of a creature whose progression was, in whole or in part, upon "all fours." To have evolved from this anatomic skeletal entity a creature whose progression is upon the posterior two of these original four legs has entailed considerable skeletal modification extending over periods of time which are almost inconceivable. The necessities of adaptation to a changing environment and to changing conditions of existence have been responsible for the varying degrees of conformity to a normal standard observed in various parts of the bony skeleton. Evolution in the osseous skeleton is progressing just as it has been in other and more thoroughly studied parts of the body, and the perfect adaptation of the body as a whole and in all its parts to the requirements of function and environment has not yet been attained. Until that period it is probable that we shall be obliged to employ our ingenuity and thought in trying to find some way to overcome the failure of the slow plodding evolutionary processes to meet the physical necessities of the organism.

One of the regions where the greatest evolutionary change has taken place in transforming a quadruped into a biped is at the juncture of the pelvic girdle with the trunk. Here there had of necessity to be very great modification in the coarse as well as in the fine adjustment of the parts. Here we find considerable variation in the size, shape, and alignment of skeletal structures. When the pelvis was adapted to sustain the weight of the posterior part of the body at right angles to the method of the biped and the muscles originating on the pelvis and operating the legs exerted their stress in a manner not now employed the inclination of the pelvis was different, and the way in which many of the articular facets inclined as well as their shape had of necessity to undergo modification. Between the four-legged progression of remote quadruped ancestry and the present human carriage there was developed the monkey, whose method of progression was in part one and in part the other, that is, in part quadrupedal and in part bipedal. A pronounced modification of the pelvic girdle had of necessity to be made in order to make such a dual method of progression possible. Now in man we have departed so far from a pelvic development of the type that prevails in the monkey that man could not if he chose, except in the earliest years of life, progress in any other way than on his "hind legs."

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[3] The Relation of Posture to Human Efficiency, J. E. Goldthwait, M.D.

[4] Boston Med. and Surg. Jour., March 16, 1911, pp. 365 to 372.

The sacrum varies greatly in size, in shape, and in the inclination with which it meets the other pelvic girdle bones. Besides these gross variations there is a variation in the shape and inclination of the articular facets. There are wide variations in the last lumbar vertebræ. In some cases the fifth lumbar has been sacralized; in others the transverse processes of the fifth are so long that they impinge upon the sides of the ilia. They are bent upward in some cases. At times there is an articulation between the tip of the transverse process and the ilia or there may be a joint between the inferior surface of the fifth transverse process and the sacrum. In still other instances there are bursæ between these fifth lumbar processes and the sacrum or the fifth and the ilia. Another anomalous situation is seen where the fifth lumbar and the sacrum are fused. This may be the case on one side, whereas on the other there is the normal anatomic condition. In some specimens there is a wide variation in the size, shape, and inclination of the articular facets on the fifth lumbar, with corresponding changes in the sacral articular processes. In those variable anatomic relations one finds the possibility of various disturbances, some of which are purely static and others are the sequels of primarily static disarrangements.

We have here in this small compass the potential of sprains of articulations between the facets holding the last lumbar upon the sacrum as well as between the supernumerary joints which may exist between the sacrum and the transverse processes of the fifth lumbar and the fifth lumbar and the ilia. Also bursal irritation in bursæ located as above described. Because of the departures from the normal in the size and shape of the articular facets occasionally there are dislocations or luxations of these facets with the signs of such anatomic disarrangements added to the signs of sprain. Furthermore, the posterior nerve roots making their exit below the transverse processes of the fifth lumbar may be compressed by the disturbed relationships of the sacrum and the last lumbar, sciatic symptoms being thus produced. Accompanying such static disarrangements we may find evidence of various arthritic lesions, notably the hypertrophic type and other non-tuberculous forms of infectious arthritis, more rarely tuberculosis. Associated with many of these lumbosacral strains the sacroiliac articulations may be involved, especially in those where the cause is one which has operated over a long period of time.

It is a specious form of logic which seeks to draw conclusions from a comparison of the behavior of two mechanisms as unlike as the most complicated machinery that man's ingenuity has constructed and the mechanics of the human body, but granting this, the fact still remains that mechanical laws are true for both and the effects of stresses, weights, and pressures of various sorts, whether in the body or in the machine, produce effects in obedience to mechanical laws common to both. Wolff's law regarding the principles of trabecular architecture in the structure of bone is an evidence of this. The materials out of which the human body is made and the biologic conditions governing growth and repair add factors which do not have to be reckoned with in the machine when interpreting the effects of faulty mechanical usage, but this constitutes one of the main differences between animate and inanimate mechanisms.

There has been a universal interest manifested in the past few years in visceral ptosis. This has been shared among surgeons, internists, and by some of those interested primarily in the specialties of gynecology, orthopedic surgery, and pediatrics. As a result of the studies evoked by the anatomist it has developed that this condition is widespread; that about one person in every five has some form of this anatomic defect; that though often acquired it is perhaps more frequently congenital, and that its influence upon growth, development, the etiology of various diseases, and general physical vigor or health in its broadest sense is considerable. As is always the case when any new departure is being made there are those whose natural conservatism restrains them from taking any active part in the movement. There are others whose scientific training puts them on the defensive at once; these are those who refuse to accept the suggestive data which have been accumulated by the pioneers in the work as indicating at all that such clues should be followed out. There are also those who swallow the bait and run away to extremes that there is no justification for even in the wildest stretches of the imagination. It remains for those who first picked up the trail to quietly persist in the search for further confirmation of the truth of their earlier suspicions. This is the present-day situation in regard to visceral ptosis, and the more apparent it becomes that a study of the terminal lesions is not destined to afford much of an explanation of the cause of the disturbances, but that primary, structural, anatomic defects may be looked upon to furnish the reason for the existence of these deformities—for that is what they would be called if we could see them with the naked eye—the more satisfactory are bound to be the results of treatment. The chances of getting at the truth of such a matter as this are hampered because of the fact that we are dependent upon at least two of the above-mentioned types of mind for the accumulation of necessary data. The operating surgeon rarely has the time to make any observations other than those incident to the technique of his operation and the pathology concerned and it is necessary that some one else should make the observation. The representative of the second type knows that it would be unscientific not to investigate, but proceeds to carry on his investigations in a spirit infinitely more reprehensible from the point of view of scientific research, in that he is a prejudiced observer from the start. The greatest harm of all, however, is done by those who without capacity for investigation, and with the commercial, though it may mask under the term scientific, spirit proceed to discover that visceral ptosis is the cause for all bodily ailments and resort to abdominal surgery for their relief.

An intelligent outlook upon the whole question will tend to correct the errors inherent in the point of view of all three different observers. The best corrective for these errors lies in an anatomico-physiologic conception of the situation. This point of view is the one that offers the most in the way of explanation of the factors leading up to the establishment of ptoses. It makes intelligible many of those conditions which seem to be the sequels of these deformities, and it supplies the basis of a rational therapy which is both preventive and corrective. There are among the ptoses two conditions at least; for purposes of description they might be classed as acute and chronic. To the first class belong those cases in which the fundamental anatomic developmental stage has not gone so far as to result in modification of physiologic function, at least to any serious degree. To the second class belong those cases in which the persistence of the anatomic anomaly has resulted in such functional physiologic maladjustments that no mere readjustment of what were the causative, primal anatomic defects is capable of restoring health. Indeed in these cases readjustment of the anatomic defect may no longer be possible.

So much more that is vital is dependent upon the normal function of the intestine than upon the normal function of a joint, or indeed of several joints, that anatomic disarrangements of the intestinal tube or other of the abdominal viscera intimately related to this functionally must of necessity give rise to more serious disturbance than any disarrangements of anatomic structures in the osseous skeleton. This is, of course, on the assumption that normal anatomic arrangement has something to do with physiologic function. In the case of the skeletal defects such interrelationships have been definitely shown. This gives, *a priori*, ground for the assumption of such interrelationships in the abdominal cavity and opens up a wide field for anatomic and pathologic research as well as for investigation of various problems in the physiologic chemistry of the body. The most obvious disturbance as a result of congenital ptosis of the intestine is the mechanical one, whereby the passage of the food through the intestine is slowed down, and constipation is often the most obvious if not the only unpleasant effect. The secondary disturbances attributable to a sluggish condition of the bowel usually receive but little attention or have but little significance attached to them. An occasional or even an habitual use of catharsis is usually the maximum amount of attention bestowed upon the symptom. Headaches, malaise, offensive breath, anorexia, etc., are taken as a matter of course and ascribed to constipation. Later on as the mechanical difficulties under which the intestinal tube has been operated have increased because of dilatation behind the point of greatest resistance, and because of the other mechanical sequels of the primary maladjustment, the original symptoms are less and less conspicuously mechanical and may become of more serious import. Among the more important of these are the various "kinks" and ileus. Chronic states of ill health, the causes of which are frequently attributed to its most conspicuous symptom, which symptom has to bear the brunt of the therapeutic batteries directed against it, and more often than not successfully withstands the attack. Chronic arthritis may be the form that the fundamental congenital defect brings to the front, or it may be that there are many other of the disease entities which our ignorance of the complexity of interrelations of biologic processes has caused us to establish the practice of referring to these visceral conditions as their cause.

Certain it is that after the mechanical phases of this maladjustment have been in operation for a time that then functional derangement of the gut sets in. It not only fails to move its contents along at a proper rate of speed, but it soon loses apparently some of its value as an absorptive membrane. At the same time the character of its contents becomes altered because of the fact that it has failed in the mechanical part of its function. All the functions of assimilation, so far as they are located in the intestine, become more or less perverted. As the condition becomes more advanced, digestion and body metabolism must be involved also, because one of the most conspicuous gross changes noted in the intestinal coats in marked cases of this sort is the atony and excessive thinning out of the walls of the intestine. This can scarcely fail, it would seem, to have some effect upon the physiologic activity of such glands as are situated in its walls.

There is reason to suppose that the multitudinous physiologic activities of the body, though they may be able to go on abnormally for some time without any very gross evidences of their maladjustment, must work together in absolute harmony in order that the functions of the organism be continuously at their highest degree of activity and that the efficiency of the individual be kept at its maximum. This state of equilibrium means health.

From what has been suggested by the foregoing it would seem evident that any measures which tend to prevent the establishment of conditions wherein faulty metabolic processes are being put in operation must be employed. In so far as these are dependent upon correctable skeletal defects, benefit will follow the employment of measures directed to the correction of such defects, and in proportion to the capacity for correction will be the benefit to the physiologic disturbance.

I have endeavored to suggest one or two ways in which the skeleton when abnormally set up may unfavorably influence the health. These have been the more obvious and better understood ways. There are many others, apparently the outgrowth of those already suggested. The part played by the ductless glands is more completely beyond knowledge at present possessed than any other physiologic process. How the function of these glands may be influenced by such physiologic disturbances as have already been spoken of it is impossible to say, but it is reasonable to suppose that they may be definitely unsettled in their activities in this manner.

It is easily understood that one of the effects produced by a pronounced visceral ptosis may be exerted upon the circulatory system in the abdominal cavity. The initial effects may be mechanical, but the remote effects may readily be physiologic. The primary disturbance may be an interference with the arterial circulation, restricting blood supply, or upon the venous circulation disturbing the return of blood from the viscera. How such disturbances may affect the functions of such important organs as the spleen and the liver, whose circulation is derived from the celiac axis of the abdominal aorta, can only be surmised. Again, it requires no great stretch of the imagination to see that the lymphatic circulation in the mesentery may be harmfully influenced by conditions of visceral ptosis. The nervous system, though consciously to us only a means of reflecting emotions to our sensoria, enabling us to act in the light of impulses which it conveys, is, nevertheless, of far more importance than such a conception would imply, and has interrelations with the organs of circulation, assimilation, and digestion which it is highly important should be kept within normal limits in order that the functional activities of the vital organs, so-called, should be capable of being carried out naturally. In childhood and youth such general processes as growth may well be influenced by the train of functional disturbances set in operation by a skeletal anomaly, whether congenital or acquired. This may apply to mental development as well as physical.

These problems comprise much of the work that those who are becoming interested in chronic medicine have lain out for themselves. A new and attractive field for investigation exists. Light is being shed upon many questions which have puzzled all branches of the profession of medicine. The need for a correlation of the knowledge which has been accumulated through the activities of workers in various special lines of research is becoming more and more evident. We are getting past the period when within the narrow limits of our particular spheres of activity we can assume a position of authority and say that this or that ailment can be treated properly only by this or that specialist. It can be properly treated only by the one who has the best conception of the anatomico-physiologic relations of the condition before him, and is broad enough to act on that knowledge. A better conception of the functional anatomic relations of the human being, not merely the ability to recognize and call by name its structural components, is what is necessary in medicine and surgery. When the profession recognizes this and bases its treatment upon such knowledge, some at least of our present-day problems are certain to become easier of solution, and mankind at large will be the gainer.

THE VALUE OF X-RAY EXAMINATIONS IN THE DIAGNOSIS OF ULCER OF THE STOMACH AND DUODENUM.[1]

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The diagnosis of ulcer of the stomach and duodenum is at times a most difficult problem. Not infrequently important symptoms are absent and the cases then become so atypical, that any

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[1] Presented at the Meeting of the Association of American Physicians in Washington, May 7, 1913.